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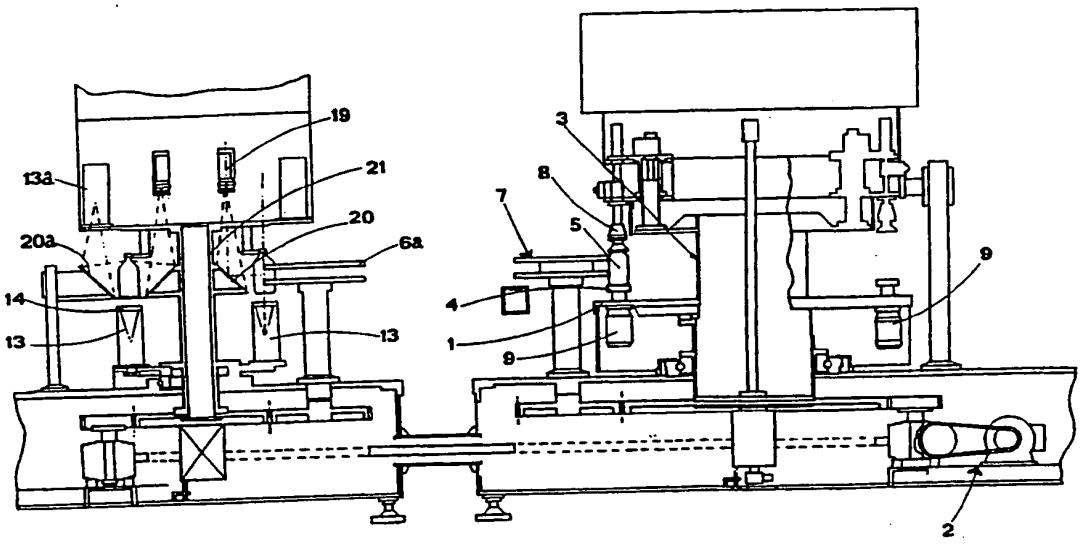

(57) Abstract

The invention relates to the field of processes and plants for inspection of containers made of transparent material and the liquid contained in the containers. More precisely, the invention relates to a process wherein during the phase of inspection of the containers (5), a contemporaneous rotation of differing containers (5) is envisaged with different speeds, by means of using a plurality of independent motor means (9). The plant, at the liquid inspection station, comprises container support elements for supporting the containers (5) in a suspended position, and a plurality of means of inspection, one for each container (5) in transit at the station.

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Procedure for inspecting transparent containers and their liquid contents.

Description.

The invention relates to a process for inspecting containers made in transparent materials and the liquid contained in them, in order to identify any defects in the containers or impurities in the liquid. The invention also relates to a plant for performing the said process.

In the field of processes and inspection plants for transparent containers, such as glass containers, filled with liquid, the prior art envisages bringing the containers, supported on rotating plates, on to a rotating platform.

The containers are examined by inspection means, for example cameras, which identify in known ways any defects in the glass of the containers and relay the information to a central control switchboard.

The containers are then set in vortical rotation, held between the plates and an upper gripping

head, so as to cause the liquid in them to swirl. The containers then exit from the rotating platform and move to a second platform where the liquid is inspected. On the second platform the containers rest on transparent plates below which light emitters are positioned, which emitters have the task of illuminating the liquid so that it can be examined by one or more cameras (fewer than the number of plates) positioned by the side of the platform.

The cameras can be fixed and aimed at examining the liquid during the brief container transit time, or they can be mobile and aimed at following the circular movement of a container for a certain angular tract of the platform (less than about 45 degrees) then to return to the initial position wherefrom another inspection cycle of a new container can begin.

In the case of fixed cameras, they can examine the container only very briefly since, in order not to penalise the productivity of the plant, the rotating platforms must be set in rotation at high speed, and thus the inspection can be insufficiently accurate and limited to one portion only of the container surface.

Mobile cameras, though permitting a longer inspection, have the drawback of requiring complex specifications to allow a synchronisation of the movement of the cameras with that of the platform and furthermore a considerable dead time during the return phase.

A further drawback is that the inspection means associated to the first rotating platform can examine the containers only when they are in a in a certain position, since when the containers are inspected the support plate is still.

A principal aim of the present invention is to obviate the abovementioned drawbacks and to realise a process and a plant which permit high productivity rates associated with a greater accuracy and reliability in of inspection both of the containers and of the liquid in them.

A further aim is to inspect all of the lateral surface of the containers.

The stated aims are fully attained by the process, object of the present invention, for inspecting containers made in transparent materials, and the liquid contained in them, to identify any defects in the containers or impurities in the liquid, characterised by what is defined in the claims

that follow, having also as its object a plant for realising the said process.

Further characteristics and advantages of the present invention will better emerge from the detailed description that follows, of a preferred but non-exclusive embodiment here illustrated in the form of a non-limiting example in the accompanying drawings, in which:

- figures 1 and 2 show schematic views of the plant respectively in plan view and in frontal elevation;
- figure 3 shows a frontal elevation which is partially sectioned and shows a detail of the second station of the plant.

With reference to the figures, 1 denotes a rotating circular platform which central shaft 3 is set in rotation by a motor 2.

The platform 1 is part of a first station of the plant wherein the inspection of the containers 5 takes place, the containers 5 being preferably made of glass or other transparent or at least translucent material, and being filled with liquid. The platform is provided in its peripheral zone with a plurality of equidistanced container support plates 4.

A gripping head 8 is positioned above each plate 4 to grip the container 5 during its rotation. Each plate 4 is equipped with its own motorisation 9 which enables the plate 4 to rotate about its own axis.

Two star transporters 6 and 7, respectively for inlet and outlet of the containers 5, with respective screws 10 and 11, bring the containers 5 to and from the platform.

While the platform describes an angle alpha comprised between 10 and 60 degrees, the entering containers 5 are set in slow rotation on the support plate so as to perform a complete rotation during the said angle alpha, and are inspected by special inspection means of known type constituted by, for example, a fixed camera 12 which relays information to a control and processing switchboard of known type and not illustrated.

In this way any defects in the container 5 are noted.

At the end of the inspection, and through a platform angle of about 170-200 degrees, the containers 5 are set in vortical rotation so as to shake the liquid contained in them. In figure 1 the containers 5 are shaded in the rotation zone.

Then the rotation speed of the plates 4 is lowered and the containers exit from the first station and enter a second station where the liquid present in them is inspected to show whether any impurities are present.

The single motors 9 constitute means which permit of differntiated and contemporaneous rotation of the plates 4.

The second station, also equipped with inlet and outlet star transporters 6a and 7a, has a contral rotation shaft 21.

A plurality of light emitters 13 and corresponding container support means rotate solidly to the central shaft 21. The support means of the containers, which suspend the containers from the neck, are constituted, for each emiter, by support elements realised by means of a fork 15 acting below an annular projection 16 present in proximity to the mouth of the container, and a shaped pad 17 which presses against the upper part of the container on the opposite side to the fork 15 in such a way as to keep the container 5 in a vertical position. A lateral support 18 keeps the container 5 vertical.

Each pad 17 can oscillate about its own fulcrum 22

and exerts its pressing action due to the presence of a spring stretched between a support 24 and a lever 25 pivoted at 22.

The lever 25 is superiorly equipped with a roller 26 running on a cam 27.

The forks 15 and the pads 17 can translate vertically, and the lateral supports 18 can translate horizontally to adapt the inspection station to various container 5 shapes.

All of the forks 15 are applied to a common plate or star which, in the case of a change in containers 5 shape, is removable from the station and subsequently reapplied with the interposition of special distancing elements which permit of varying the vertical position of the forks 15. The pads 17 and lateral supports 18 can be adjusted in a similar way. The forks 15 can also be mounted on a plane which can slight up and down along the central shaft, so as further to simplify the adaptation operation, making it possible with a single mechanical command.

Each light emitter 13 is superiorly protected by a sheet 14 of transparent material, preferably tempered glass, and is associated to an inspection means, for example a camera 19 which identifies

any impurities in the liquid contained in the container 5. Each container 5 is suspended above a corresponding light emitter 13, the light from which crosses the container 5 longitudinally and if it meets an impurity or a solid particle in the liquid, is reflected by a mirror 20 arranged at about 45 degrees and solid to the central shaft 21, towards a camera 19, which sends the information to a rotating control and processing switchboard of known type. The impurities are read as luminous points, absent if the liquid is homogeneous and clean.

The cameras 19, one for each light emitter 13, are solid to the central shaft and each of them effects an inspection while the central shaft describes an angle of about 180 degrees, or at most between 170 amd 200 degrees. In figure 2 the containers 5 in transit in the liquid inspection zone have been shaded.

20a indicates a fixed truncoconical mirror, solid to the non-rotating part of the second station, which mirror 20a reflects the light coming from an emitter 13. The reflected light crosses the container 5 laterally to be further reflected by the mirror 20 towards the camera 19. In this way,

the presence of an impurity in the liquid is identified by the camera as a dark spot in the light beam. The mirror 20a is positioned in a terminal part 30 opf the liquid inspection zone and is of about 20-55 degrees. At the exit of the second station there is a deviator, not illustrated since of known type, which deviates defective containers 5 or containers containing defective liquid, towards a waste collection zone. Both of the inspection stations, like the relative inlet and outlet star transporters, are motorised by a single motor 2.

The plant which is the object of the invention permits continuous and not step-by-step movement of the containers 5 and thus reaches a higher level of productivity than is possible with conventional plants, succeeding at the same time in effecting a more accurate inspection since it performs for a longer period of time and over all of the surface of the containers.

A further advantage with respect to traditional plants where the containers move step-by-step is that the present invention confers a greater stability on the liquid.

Furthermore, having provided for suspending the

containers 5 by their necks in the second station, scratches on the light emitter protection sheet can be avoided, which scratches are the cause of shadows and drawbacks during the inspection phase.

Claims.

1. A process for inspecting containers made of transparent material and liquid contained in them, to identify any defects in the containers or impurities in the liquid, comprising the phases of:

- inlet of the containers (5) to a first inspection station of the containers (5);
- inspection of the single containers (5);
- rapid rotation of the containers (5) about the said containers (5) vertical axis, causing agitation of the liquid contained in them;

stopping of the rotation and exit of the containers (5) from the first station;

- inlet of the containers (5) to a second inspection station where, while the containers (5) are in transit, the liquid is inspected while it is still in a state of agitation due to the rapid rotation imposed on it at the first station,

characterised in that at the first station a contemporaneous rotation is given to differing

containers (5) at different rotation speeds.

2. A process as in claim 1, characterised in that the first inspection of the containers (5) at the first station happens while the containers (5) rotate through 360 degrees before inpection means of the said containers (5).

3. A process as in claim 1, characterised in that at the second station the inspection phase continues through an arc of about 180 degrees performed by a movement of the second station itself.

4. A plant for inspection of containers made of transparent material and liquid contained in them in order to identify any defects in the containers (5) or impurities in the liquid, of the type comprising:

- a first station constituted by a platform (1) rotating about its own axis and provided with a plurality of plates (4) rotating about their own axes and uniformly distributed in proximity of the peripheral zone of the platform (1), a gripping head (8) being associated to each plate (4) to grip and hold the container (5) between the head

(8) and the plate (4) during a rotation of the plate (4), the platform (1) being equipped with inlet transporters (6) and outlet transporters (7) for the containers (5), container inspection means being associated to the said first station for inspection of the containers (5) in transit at the station;

- a second rotating station equipped with means for inspecting the liquid present in the containers (5) while the containers (5) are in transit at the second station;

characterised in that it comprises means to permit of differentiated rotation of the plates (4) and to vary a rotation velocity of single plates (4), contemporaneously setting different plates (4) in rotation at different rotation speeds.

5. A plant as in claim 4, characterised in that the means consenting differentiated rotation of the plates (4) comprise a plurality of motor means (9), one for each plate (4), which motor means (9) are individually activatable.

6. A plant for inspecting containers made of transparent material and liquid contained in them,

to identify any defects in the containers or impurities in the liquid, of the type comprising:

- a first station constituted by a platform (1) rotating about its own axis and provided with a plurality of plates (4) rotating about their own axes and uniformly distributed in proximity of the peripheral zone of the platform (1), a gripping head (8) being associated to each plate (4) to grip and hold the container (5) between the head (8) and the plate (4) during a rotation of the plate (4), the platform (1) being equipped with inlet transporters (6) and outlet transporters (7) for the containers (5), container inspection means being associated to the said first station for inspection of the containers (5) in transit at the station;
- a second rotating station equipped with support means for the containers (5) rotating solid with the station and associated to light emitters (13) positioned below the containers (5), being separated from the said containers (5) by a sheet of transparent material, and being equipped with means for inspecting the liquid present in the containers (5) while the containers (5) are in transit at the second station;

characterised in that the support means of the containers (5) transiting at the second station comprise support elements of the containers (5) in a suspended position, above the said transparent sheet and the light emitters (13).

7. A plant as in claim 6, characterised in that the container support means comprise, associated to each container (5):
- a gripping and holding fork (15) of the container (5) at its neck, acting below an annular projection (16) present in proximity of the container (5) mouth;
- a shaped pad (17) which presses against an upper part of the container (5) on an opposite side with respect to the fork (15), to keep the container (5) in a position where its axis is vertical;
- a lateral support (18) which contacts the container (5) in proximity of a container base, to enhance a vertical alignment of the container (5).

8. A plant as in claim 7, characterised in that it comprises means to adjust a positioning level of all of the forks (15) at the station, as well as positioning levels of all of the pads (17) and the

lateral supports (18), in accordance with container (5) sizes.

9. A plant for inspecting containers made of transparent material and liquid contained in them, to identify any defects in the containers or impurities in the liquid, of the type comprising:
- a first station constituted by a platform (1) rotating about its own axis and provided with a plurality of plates (4) rotating about their own axes and uniformly distributed in proximity of the peripheral zone of the platform (1), a gripping head (8) being associated to each plate (4) to grip and hold the container (5) between the head (8) and the plate (4) during a rotation of the plate (4), the platform (1) being equipped with inlet transporters (6) and outlet transporters (7) for the containers (5), container inspection means being associated to the said first station for inspection of the containers (5) in transit at the station;
- a second rotating station equipped with support means for the containers (5) rotating solid with the station and associated to light emitters (13) positioned below the containers (5), being

separated from the said containers (5) by a sheet of transparent material, and being equipped with means for inspecting the liquid present in the containers (5) while the containers (5) are in transit at the second station;
characterised in that the means for inspecting the liquid in the containers (5) are equal in number to the containers (5) in transit at the second station, a means of inspection being associated to each container (5), which means of inspection rotates solidly both with the second station and the container (5).

10. A plant as in claim 9, characterised in that the means of inspection comprise, for each container (5), a camera (19) positioned parallel to and above the container (5) to identify a reflected image of the container (5) from a mirror (20) positioned by a side of the container (5) and rotating solidly with a central shaft (21) of the second station together with the camera (19), the mirror (20) reflecting light coming from a light emitter (13) when the emitter (13) meets impurities in the liquid in the container (5).

11. A plant as in claim 9, characterised in that the means of inspection comprise, for each container (5), a camera (19) positioned parallel to and above the container (5) to identify a reflected image of the container (5) from a mirror (20) positioned by a side of the container (5) and rotating solidly with a central shaft (21) of the second station together with the camera (19), the mirror (20) reflecting light coming from a light emitter (13a) after the light has been reflected by a fixed mirror (20a) and has crossed the container (5) laterally.

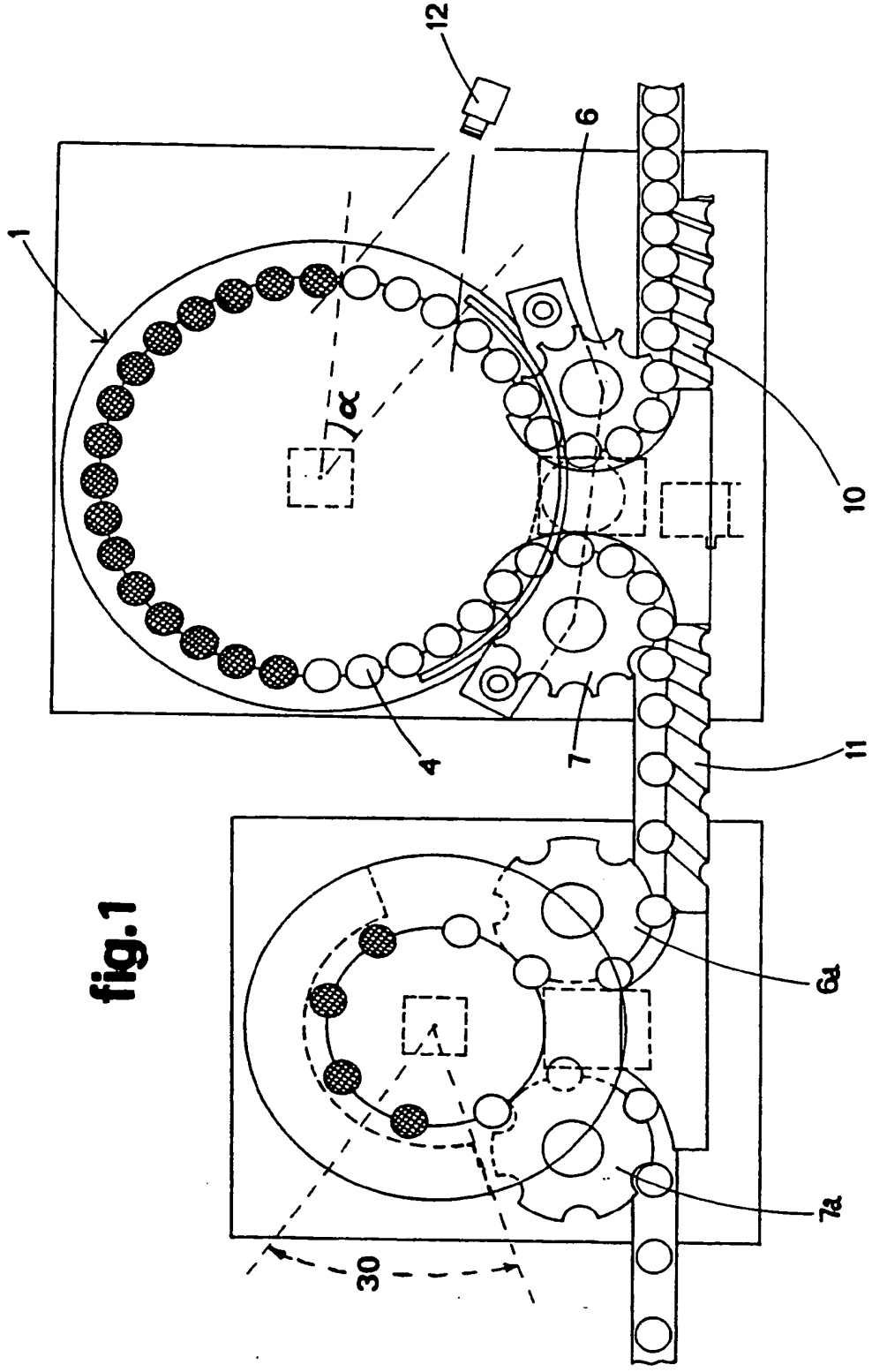


fig.1

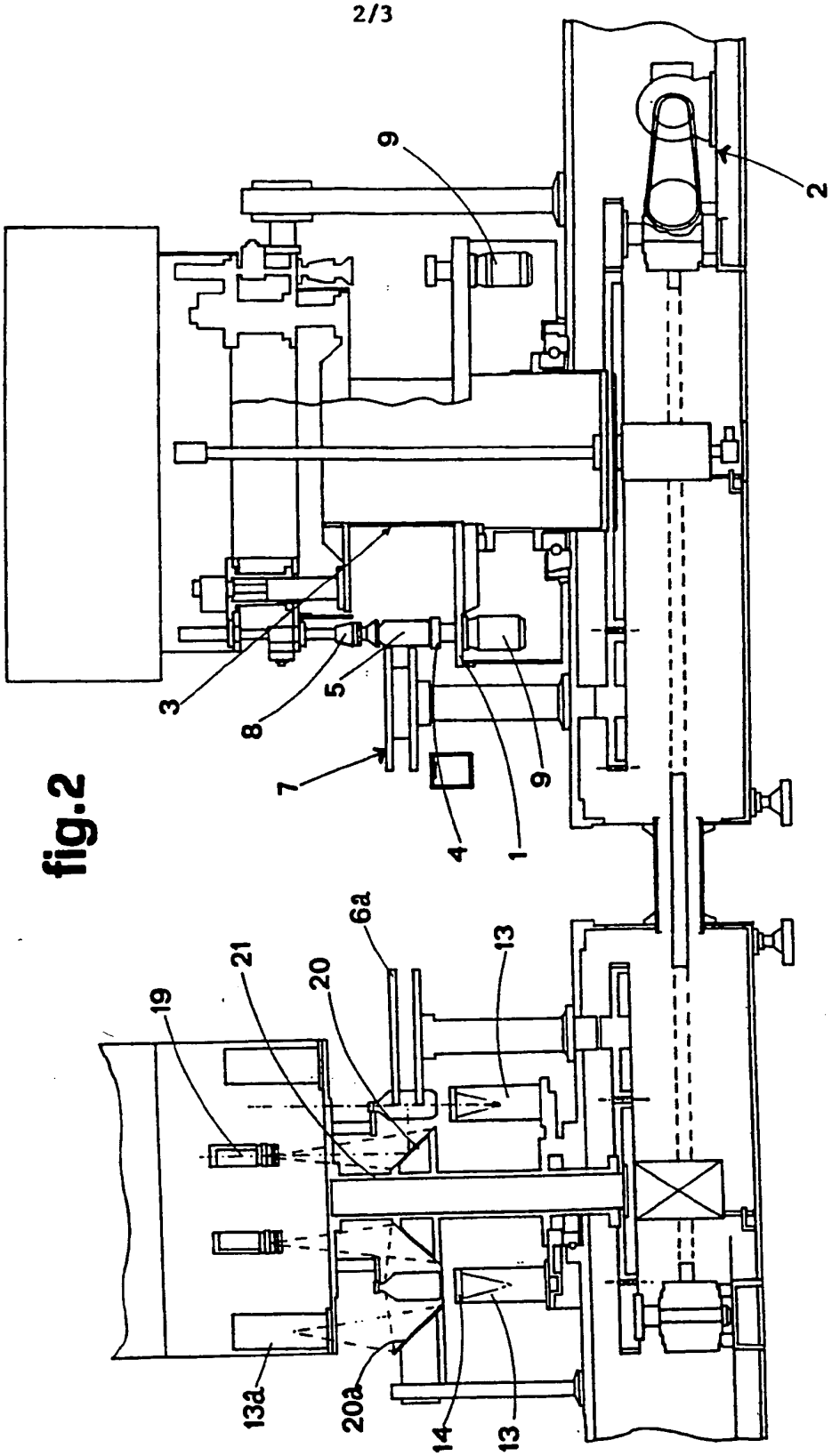
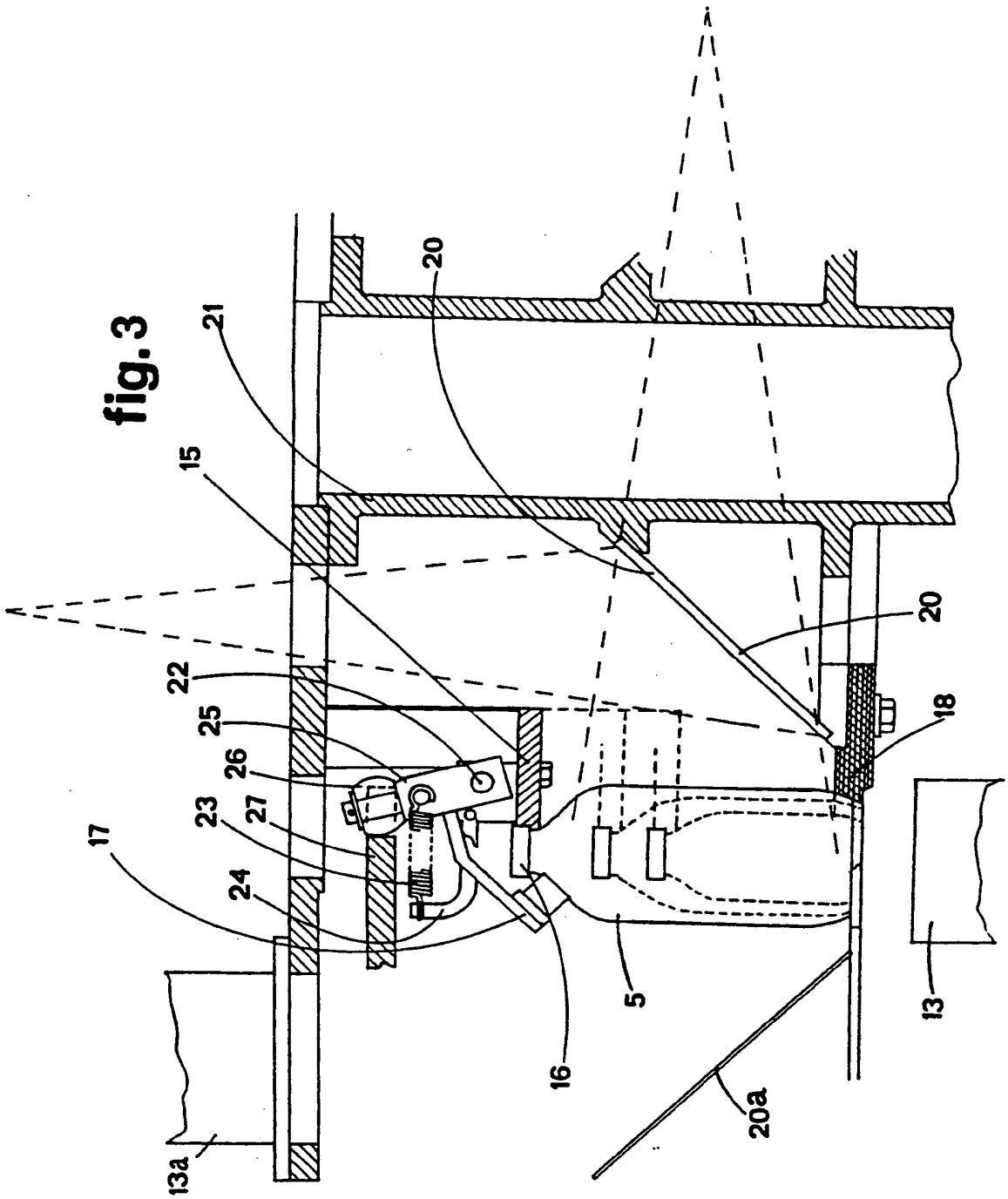


fig.2

fig.3



INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 93/00095

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G01N21/90

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 G01N B07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 172 524 (HOLM) 20 October 1979 see abstract see column 6, line 14 - line 61 see column 7, line 12 - line 20 see column 7, line 37 - line 44 see column 9, line 57 - line 66 see figures 1-5 ---	1,4,6,7, 9,10
A	US,A,3 765 533 (STEPHENS) 16 October 1973 see abstract see column 2, line 44 - line 50 see column 4, line 12 - line 44 see column 6, line 60 - line 63 see figures 1,5,6,8 --- -/--	1,4,6,7, 9,10

[X] Further documents are listed in the continuation of box C.

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12 January 1994	19. 01. 94

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US,A,3 811 567 (TOMITA) 21 May 1974 see column 7, line 12 - line 45 see figures 1-4,6	1,4,6,9, 10
A	GB,A,2 001 751 (EISAI) 7 February 1979 see page 2, line 89 - line 102; figures	1,4,6,9, 10
A	US,A,3 651 937 (KRONSEDER) 28 March 1972 see column 3, line 28 - line 34 see column 3, line 51 - line 54 see column 5, line 36 - line 42 see figures 1,8	1,4,6,8, 9

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Int[redacted]nal Application No
P[redacted]T 93/00095

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